XLVIII. *A Proposal for measuring the Attraction of some Hill in this Kingdom by Astronomical Observations. By the Rev.* Nevil Maskelyne, *B. D. F. R. S. and Astronomer Royal.*

Redde in the year 1772.

IF the attraction of gravity be exerted, as Sir ISAAC NEWTON supposes, not only between the large bodies of the universe, but between the minutest particles of which these bodies are composed, or into which the mind can imagine them to be divided, acting universally according to that law, by which the force which carries on the celestial motions is regulated; namely, that the accelerative force of each particle of matter towards every other particle decreases as the squares of the distances increase, it will necessarily follow, that every hill must, by its attraction, alter the direction of gravitation in heavy bodies in its neighbourhood from what it would have been from the attraction of the earth alone, considered as bounded by a smooth and even surface. For, as the tendency of heavy bodies downwards perpendicular to the earth's surface is owing to the combined attraction of all the parts of the earth upon it, so a neighbouring mountain ought, though in a far less degree, to attract the heavy body towards its centre of attraction, which cannot be placed far from the middle of the mountain. Hence the plumb-line of a quadrant, or any other astronomical instrument, must be deflected from its proper situation by a small quantity

towards the mountain; and the apparent altitudes of the ſtars, taken with the inſtrument, will be altered accordingly.

It will eaſily be acknowledged, that to find a ſenſible attraction of any hill from undoubted experiment would be a matter of no ſmall curioſity, would greatly illuſtrate the general theory of gravity, and would make the univerſal gravitation of matter palpable, if I may ſo expreſs myſelf, to every perſon, and fit to convince thoſe who will yield their aſſent to nothing but downright experiment. Nor would its uſes end here; as it would ſerve to give us a better idea of the total maſs of the earth, and the proportional denſity of the matter near the ſurface compared with the mean denſity of the whole earth. The reſult of ſuch an uncommon experiment, which I ſhould hope would prove ſuccefsful, would doubtleſs do honour to the nation where it was made, and the ſociety which executed it.

Sir ISAAC NEWTON gives us the firſt hint of ſuch an attempt, in his popular Treatiſe of the Syſtem of the World, where he remarks, " That a mountain of an he-" miſpherical figure, three miles high and ſix broad, will " not, by its attraction, draw the plumb-line two minutes " out of the perpendicular." It will appear, by a very eaſy calculation, that ſuch a mountain would attract the plumb-line 1′ 18″ from the perpendicular.

But the firſt attempt of this kind was made by the French Academicians, who meaſured three degrees of the meridian near Quito in Peru, and who endeavoured to find the effect of the attraction of Chimboraço, a

5   mountain

mountain in that neighbourhood, which is elevated near four miles above the sea, though only about two miles above the general level of the province of Quito. By their obfervations of the altitudes of fixed ftars taken with a quadrant of $2\frac{1}{2}$ feet radius, they found the quantity of 8″ in favour of the attraction of the mountain, by a mean of their obfervations. This, indeed, was much lefs than they expected; but then it is to be confidered, that their inftrument was too fmall and imperfect for the purpofe; and that they themfelves were fubject to great inconveniencies, being fheltered from the wind and weather by nothing but a common tent, and placed fo high up the mountain as the boundary where the fnow begins to lie unmelted all the year round. And indeed their obfervations, doubtlefs owing to thefe caufes of error, differ greatly from one another, and are therefore infufficient to prove the reality of an attraction of the mountain Chimboraço, although the general refult from them is in favour of it. Accordingly, one of the French gentlemen themfelves, M. BOUGUER, who drew up the account of their experiment, expreffes his wifhes, that a like experiment might be made, to find the attraction of a mountain in France or England, where he thinks fome might be found of fufficient bulk for the purpofe. This experiment and thefe remarks were made in the year 1738, or above thirty years ago, yet I believe no fimilar experiment has ever been made in Europe.

I have made inquiries after a proper hill in this kingdom, for the trying of fuch a curious experiment, and

have

have been informed of two places in particular, extremely convenient for the purpofe. The one is fituated on the confines of Yorkfhire and Lancafhire; where, within the compafs of twenty miles, are fituated four very remarkable hills, called Pendle-hill, Pennygant, Ingleborough, and Whernfide, which have been eftimated to be from 600 to 750 yards elevated above the plane of the vales between them. By calculation on thefe *data*, it fhould follow, that the fum of the contrary attractions of Whernfide, the largeft of thefe hills, on the plumb-line placed half-way up the hill, would not be lefs than 30″, and might amount to 46″, which it is evident is a very confiderable quantity, and fufficient to give us room to hope for a favourable and fatisfactory fuccefs of the experiment. The other place pointed out for this purpofe, is a valley two miles broad, between the hills Helwellin and Skidda, in Cumberland; which hills, according to a plan of them and the adjacent country, communicated by Mr. SMEATON, F.R.S. are elevated above 1000 yards above the intermediate valley. By a calculation made according to this plan, the fum of the contrary attractions of the plumb-line, placed alternately on the North-fide of Helwellin and the South-fide of Skidda, amounts to about 20″, which is likewife a quantity large enough for the experiment. And although the denfity of the earth near the furface fhould be five times lefs than the mean denfity, as there is fome reafon to fufpect, and the attractions, as here ftated, fhould confequently be diminifhed in the proportion of five to one, ftill the fum of the contrary attractions of Whern-

fide

fide would be 6″ or 9″, and the fum of the contrary at-
tractions of Helwellin and Skidda would be 4″; which
quantities are not too fmall to be meafured and demon-
ftrated by an accurate zenith fector, fuch as that belong-
ing to the Royal Society, which I made ufe of at St. He-
lena, would be, if the fault in the fufpenfion of the
plumb-line, which I there difcovered, was corrected,
in the manner fuggefted in the Philofophical Tranfac-
tions, vol. LIV. p. 351.